

PRIMARY STUDIES OF CHINESE SPACEBORNE SAR

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P-3

ABSTRACT

This paper deals with the primary studies on spaceborne synthetic aperture radar (SAR) in China. The SAR will be launched aboard a Chinese satellite and operated at L-band with HH polarization. The purpose of the mission in consideration is dedicated to resources and environment uses, especially to natural disaster monitoring. The ground resolution is designed as 25 m x 25 m for detailed mode and 100 m x 100 m for wide scan-SAR mode. The off-nadir angle can be varied from 20 to 40 degrees. The key system concepts are introduced here.

I. INTRODUCTION

It is well known that SAR can map the Earth surface under poor optical conditions. Spaceborne SAR data can be widely used for natural resources exploration and environment monitoring. SAR is also suggested as the most important payload for a natural disaster reduction satellite system, which has been considered by many countries and international organizations. To meet the requirement for all-weather Earth observation of remote sensing users both from China and around the world, China is considering the development of a Chinese spaceborne SAR system. The primary studies on related techniques are conducted in the framework of the National High-Tech Research and Development Plan of China, which is to develop techniques to be industrialized and practically applied by the end of this century. The primary studies on spaceborne SAR show that the SAR operated at L-band in a sun-synchronized circular orbit can partly fulfill the tasks suggested by Chinese users for flood disaster monitoring and other resources and environment related fields.

The SAR will use horizontally polarized L-band (wavelength 23.5 cm) for both transmitting and receiving of the SAR signal. Two operating modes, detailed mode and wide scan-SAR mode, can be chosen by ground instructions according to different working tasks. The satellite will also have a limited orbit change capability to meet the need of flood monitoring in the eastern part of China, where flood disasters every summer are common. This capability means that the satellite can be changed to a lower orbit which is frozen to over East China.

In past years, China has used airborne SAR to monitor flooding areas during the flood season. An airborne SAR system developed in China played an important role in this kind of monitoring. This system, working in X-band with four polarizations, has a resolution of 10 m x 10 m, a swath width of 35 km, and an acting range of 150 km. This experience contributed greatly to the studies on spaceborne SAR in China.

The primary results presented here are based on the mission study, on domestic experience with airborne SAR systems, and on SAR data processing.

II. MISSION

The Chinese spaceborne SAR mission will no doubt meet many requirements for SAR data in resources and environment uses. Applications of importance to China also includes flood and drought monitoring. The SAR system will be onboard a Chinese satellite with a circular sun-synchronized orbit. The orbit parameters are shown as Table 1.

Table 1. Parameters of Chinese SAR Satellite

Orbit height	608 km
Orbit inclination	97.8°
Orbit period	96.83 min.
Repetitive period	31 day
Number of revolutions per day	14+27/31
Total number of revolutions	461
Local time of descending node	10:30
Orbit regression	24.2° westward
Space between neighbor orbits	81.7 km (equator) 75.5 km (20°)

The planned satellite will be a 3-axis stabilized one. The orbit is chosen according to the consideration of Earth coverage and better S/N ratio in the SAR operation under the power allocated to the SAR system.

The SAR system is designed according to user requirements that demand a variety of incidence angles from 20 to 40 degrees. A microstrip array antenna measuring 12.5 m x 2.5 m is considered with electronic beam steering capability. Selected radar characteristics are listed as Table 2.

Table 2. Chinese Spaceborne SAR Characteristics

Frequency	1.275 GHz
Wavelength	23.5 cm
Polarization	HH
Off-nadir angle	20-40°
Spatial resolution	25 m / 100 m
Swath width	100 km / 400 km
Pulse bandwidth	20 MHz
Pulse length	33 micro sec.
Pulse repeat frequency	Selectable
Noise equivalent	< -20 dB
Quantization bit number	3 or 5
Down link data rate	100 Mb/s

The SAR system will transmit a linear frequency modulated signal, which is generated by the use of a surface acoustic device. A solid state high-power amplifier will be used for transmitting high-peak power probing signals. The SAR electronics for use onboard the satellite are being developed. The primary studies on the spaceborne SAR show the possibility that the requirements of spaceborne SAR to the space platform can be realized.

Techniques for spaceborne SAR image processing are developed in the primary studies and SAR images have been reconstructed. Studies on the applications of spaceborne SAR data are also being carried out in geology, hydrology, agriculture, forestry, oceanology, and surveying and mapping. We believe that a mature user group will be the key to the successful realization of the future Chinese spaceborne SAR project.

For peaceful uses of space remote sensing technology, we are looking forward to having international collaboration with other countries in the field of spaceborne imaging radar development.

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